

CLAIMS

What is claimed is:

1. A method enabling automated repair of defects with a material placement machine, the method comprising:

5 inspecting a composite structure for defects;

determining whether a defect detected by the inspecting is unacceptable;

10 determining whether a defect detected by the inspecting is repairable by the material placement machine without user intervention; and

15 automatically causing the material placement machine to return to and place material sufficient for repairing a defect determined to be unacceptable and repairable by the material placement machine without user intervention.

2. The method of claim 1, further comprising automatically causing the material placement machine to return to each defect determined to be unacceptable.

20 3. The method of claim 1, wherein the automatically causing includes electronically accessing positional data defining a location of a defect.

25 4. The method of claim 1, wherein the automatically causing includes creating a program to automatically generate instructions for causing the material placement machine to return to and place material sufficient for repairing defects determined to be unacceptable and repairable by the material placement machine without user intervention.

30 5. The method of claim 1, wherein the inspecting includes:
illuminating at least a portion of the composite structure;
acquiring an image of the illuminated portion of the composite structure; and

analyzing the image to identify defects in the illuminated portion of the composite structure.

6. The method of claim 1, further comprising exterior monitoring of the material application position of the material placement machine to determine a location of a defect detected by the inspecting.

7. A method comprising:
 - inspecting a composite structure for defects;
 - determining whether a defect detected by the inspecting is unacceptable; and
- 5 automatically causing the material placement machine to return to a defect determined to be unacceptable.
8. The method of claim 7, further comprising:
 - 10 determining whether a defect is repairable by the material placement machine without user intervention; and
 - automatically causing the material placement machine to return to and place material sufficient for repairing a defect determined to be unacceptable and repairable by the material placement machine without user intervention.
- 15 9. The method of claim 7, wherein the automatically causing includes electronically accessing positional data defining a location of a defect.
10. The method of claim 7, wherein the automatically causing includes
 - 20 creating a program to automatically generate instructions for causing the material placement machine to return to a defect determined to be unacceptable.
11. The method of claim 7, wherein the inspecting includes:
 - 25 illuminating at least a portion of the composite structure;
 - acquiring an image of the illuminated portion of the composite structure; and
 - analyzing the image to identify defects in the illuminated portion of the composite structure.
- 30 12. The method of claim 7, further comprising exterior monitoring of the material application position of the material placement machine to determine a location of a defect detected by the inspecting.

13. A method comprising:
electronically accessing positional data defining a defect location on
a composite structure; and
automatically causing the material placement machine to return to
5 the defect location as defined by the positional data.

14. The method of claim 13, wherein the automatically causing includes
automatically causing the material placement machine to place material sufficient
for repairing a defect at the defect location.

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15. The method of claim 14, wherein the automatically causing includes
automatically causing the material placement machine, after completing a ply of
the composite structure, to return to a course of the ply in which a defect is
located and place material along the course sufficient for repairing the defect.

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16. The method of claim 14, wherein the automatically causing
includes creating a program to automatically generate instructions in connection
with the positional data, for causing the material placement machine to return to
the defect location as defined by the positional data and place material sufficient
20 for repairing the defect at the defect location.

17. The method of claim 16, wherein the program extracts the
positional data from a first file to a second file and generates the instructions
within the second file.

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18. The method of claim 14, further comprising determining whether a
defect is repairable by the material placement machine without user intervention,
and wherein the automatically causing includes automatically causing the
material placement machine to repair a defect determined to be repairable by the
30 material placement machine without user intervention.

19. The method of claim 13, further comprising inspecting the
composite structure for defects by:

illuminating at least a portion of the composite structure;
acquiring an image of the illuminated portion of the composite structure; and
analyzing the image to identify defects in the illuminated portion of
5 the composite structure.

20. The method of claim 13, further comprising exterior monitoring of the material application position of the material placement machine to determine a first distance from a first reference point of the composite structure to a defect.

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21. The method of claim 20, wherein the monitoring includes detecting and counting transitions between contrasting portions of a code ring coupled for common rotation with the compaction roller.

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22. The method of claim 20, further comprising:
summing courses completed to produce a total completed course count; and
multiplying a predetermined course width by the total completed course count to determine a second distance from a second reference
20 point of the composite structure to the defect.

23. The method of claim 22, wherein summing courses completed includes tracking receipt of signals from a machine load cell indicating whether pressure is being applied to a compaction roller.

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24. The method of claim 13, further comprising determining whether a defect is unacceptable, and wherein the automatically causing includes automatically causing the material placement machine to return to a defect determined to be unacceptable.

25. A program enabling automated repair of defects with a material placement machine, the program comprising:

a plurality of inputs to enable the program to access positional data defining a defect location on a composite structure; and

5 a module for automatically generating instructions in connection with the inputs, for automatically causing a material placement machine to return to the defect location as defined by the positional data and place material sufficient for repairing the defect at the defect location.

10 26. The program of claim 25, further comprising a module for extracting positional data from a first file to the second file, the second file including the instructions generated by the program.

15 27. The program of claim 25, wherein the module automatically generates instructions for automatically causing the material placement machine, after completing a ply of the composite structure, to return to a course of the ply in which a defect is located and place material along the course sufficient for repairing the defect.

20 28. The program of claim 25, wherein the module automatically generates instructions for automatically causing the material placement machine to repair only defects which are determined to be unacceptable.

25 29. The program of claim 25, wherein the module automatically generates instructions for automatically causing the material placement machine to repair only defects which are determined to be repairable by the material placement machine without user intervention.

30 30. The program of claim 25, further comprising a module for communicating with an inspection system capable of inspecting the composite structure for defects by:

illuminating at least a portion of the composite structure;

acquiring an image of the illuminated portion of the composite structure; and

analyzing the image to identify defects in the illuminated portion of the composite structure.

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31. The program of claim 25, further comprising a module for communicating with an inspection system capable of determining a location of a defect by exterior monitoring of the material application position of the material placement machine.

32. A program comprising:

a plurality of inputs for enabling the program to access positional data defining a defect location on a composite structure; and

5 a module for automatically generating instructions in connection with the inputs, for automatically causing a material placement machine to return to the defect location as defined by the positional data.

33. The program of claim 32, further comprising a module for extracting positional data from a first file to the second file, the second file including the 10 instructions generated by the program.

34. The program of claim 32, wherein the module automatically generates instructions for automatically causing the material placement machine to return to only defects which are determined to be unacceptable.

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35. The program of claim 32, further comprising a module for communicating with an inspection system capable of inspecting the composite structure for defects by:

illuminating at least a portion of the composite structure;

20 acquiring an image of the illuminated portion of the composite structure; and

analyzing the image to identify defects in the illuminated portion of the composite structure.

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36. The program of claim 32, further comprising a module for communicating with an inspection system capable of determining a location of a defect by exterior monitoring of the material application position of the material placement machine.